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ACCELERATION TOLERANCES OF THE HUMAN BODY

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COMBINED INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

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ACCELERATION TOLERANCES OF THE HUMAN BODY

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SUMMARY

An accelerative force of 10 G during 0.01 seconds on against the head causes symptoms of cerebral concussion. An accelerative force of 34.3 with the body supported by the chest and abdomen in a fashion analogous to seat belt and shoulder harness support is the maximum tolerated without symptoms of cerebral concussion. The limit of acceleraitve forces tolerable by the body is limited by the degree of force transmitted to the head which cannot exceed 10 G.

ACCELERATION TOLERANCES OF THE HUMAN BODY

1. Introduction.

The German aviation medical research reported herein was done in order to obtain information on the following subjects:

(a) Aircraft crashes and design as related to protection of personnel.
(b) Design of ejection seats.
(c) Design and tactical use of aircraft for mid-air ramming of other aircraft. The limit of tolerance of the human body for acceleration forces of short duration was thought to be of sufficient importance to warrant considerable emphasis on this work.

This research was done by the Medizinisches Forschungsinstitut, Garmisch-Partenkirken under the direction of Dr. Urich Henschke.

2. Procedure

A large swing was constructed with a platform large enough to support a man in the prone position. A strong wire cable was used to stop the platform at the bottom of its swing. The amount of G developed and its duration were varied and measured by recording accelerometers and checked by calculations.

Figures 1 to 8 show diagramatically the various positions used in this study. The positions as shown in Figures 7 and8 show the means used for absorbing the accelerative forces and thereby increasing the tolerance. The position shown in Figure 1 was used by only one individual, namely Dr. Henschke. The other positions were used by seven subjects. The subjects were six German scientists and one German soldier. In so far as could be determined, prisoners of war and displaced personnel were not used. The end point for these experiments was headache or any symptom which might be caused by cerebral concussion.

3. Result.

The limit of tolerance for each position is shown in Figures 1 to 8; with the exception of the first position,

the limit of tolerance is the average of the seven subjects. Specific interrogation concerning the positions shown in Figures 2 and 5 revealed that the support was limited to the chest and back and that the head was not given any support.

4. Discussion.

The method used for determining the amount of force transmitted to the head in the positions shown in Figures 2 and 8 is not clear. Accordingly, the statement that the limit of tolerance is determined by the force transmitted to the head should be considered as a theoretical concept.

The position shown in Figure 5 is analogous to the position and support given by the conventional aircraft seat belt and harness. It may be theorized that if the limit of tolerance as considered in this report is 34.3 G, the human body may be subjected to greater forces than this and recover from the injury sustained. It would seem, therefore, that cockpit, seat, seat belt and harness should be designed to withstand, during crashes, at least 34 G.

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MAXIMUM TOLERATED DECELERATION

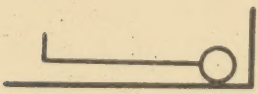
Fig. 1  10 G.

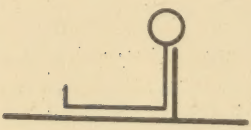
Fig. 2  28.8 G

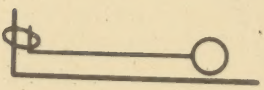
Fig. 3  31.0 G

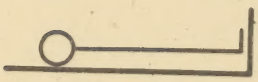
Fig. 4  33.6 G

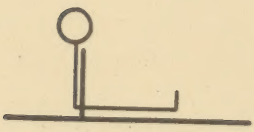
Fig. 5  34.3 G

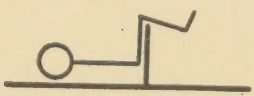
Fig. 6  36.5 G

Fig. 7  69.5 G

Fig. 8  86.0 G

Direction of decelerative force: ←. Duration: 0.01 Sec.